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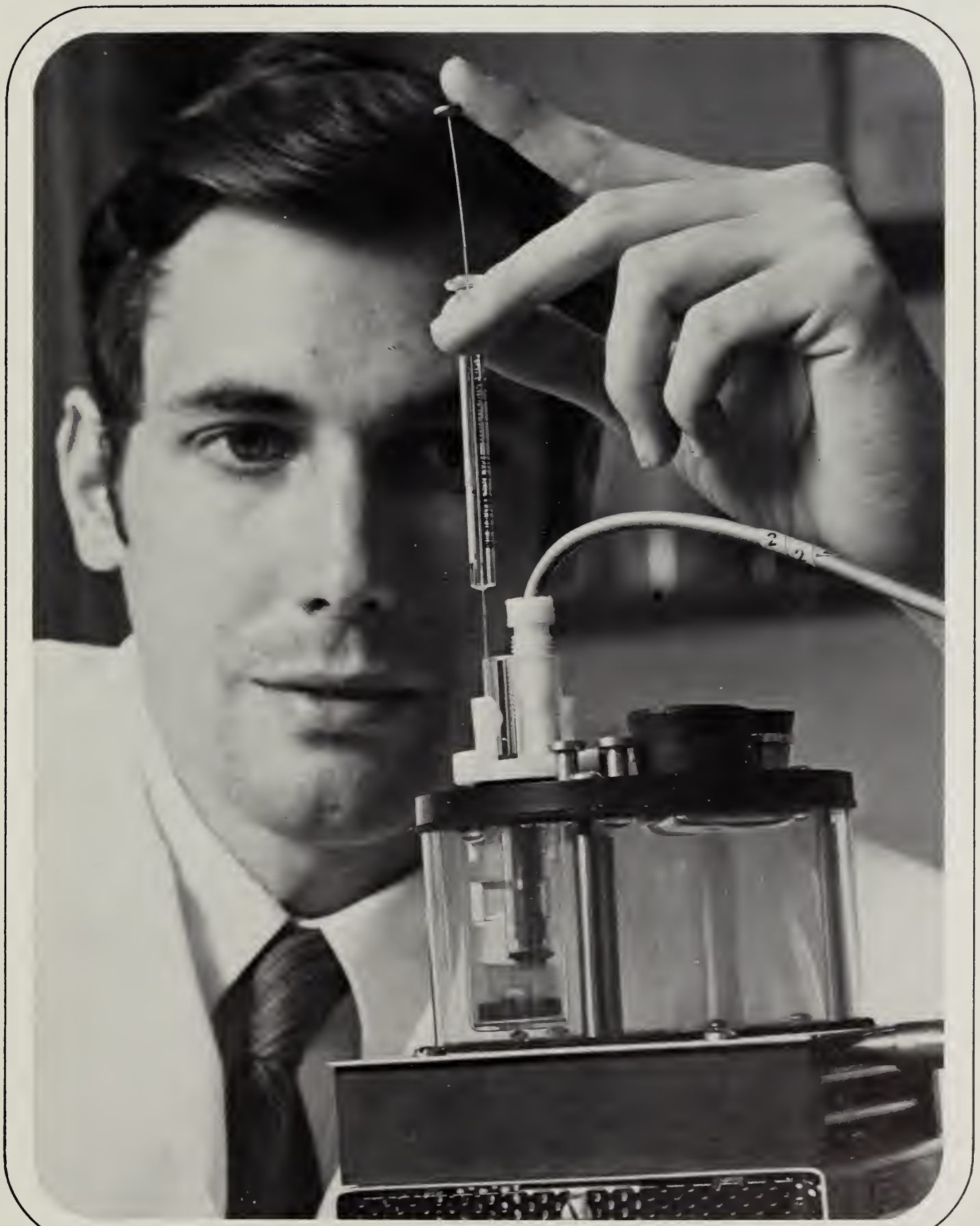

MARCH 1971

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Coping with Adverse Weather

Man has harnessed the atom, but he hasn't saddled the weather.

Since the dawn of agriculture when man began tilling the earth with a planting-stick, his efforts have been subject to the vagaries of weather and climate. In good crop years and bad, temperature, water supply, and light continue to exert the big three environmental influences that wield decisive power over plant life. Perhaps in the next century, entire farms, orchards, and nurseries will be enclosed by gigantic plastic houses, with every plant grown under completely controlled conditions. But for the present we must strive to provide an ideal local climate for growth in the immediate vicinity of plants.

This microclimatic approach, of course, involves some lore and skills that go back to antiquity. Farmers and gardeners have long known, for example, that plantings sheltered by a hedge or wall "warm up" and commence early growth, as do those on a sun-bathed southern slope. They also used mulches of straw and stone, forerunners to today's black plastic. And they sought out plants that withstood adverse weather better than fellow plants, thereby improving the genetic constitution of future crops.

More recently, ARS scientists and their colleagues have adapted these old methods to modern agriculture. Soybeans give higher yields when shielded from drying winds by windbreaks of corn. Similarly, rows of sunflowers interplanted among strawberries serve as living snowfences to collect snow and ward off winter injury. And improving on conventional mulches, ARS scientists have developed a biodegradable foam to blanket and insulate young truck crops against late or unexpected spring freezes (page 4).

The world of chemistry is also playing an important role in helping plants survive freezing weather. Antidesiccants can be applied to the plant as a coating of wax or latex to reduce evapotranspiration, for strong winds literally suck water from the leaves of such ornamentals as magnolias and hollies. And working at the molecular level, ARS scientists are finding chemicals which switch off the plant's systems, thereby inducing dormancy in the vulnerable buds of trees and shrubs.

There are many missing parts to the puzzle of helping plants withstand weather-induced stresses. So far science has fit only a few parts together. The other parts will come in a slow, orderly progression, so that ultimately we will do a better job of growing plants in the face of adverse weather.

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COVER: In a revolutionary plant breeding method (page 3), Dr. Robert G. McDaniel adds an organic acid, which acts as an energy source, to the mitochondria from barley. The ability of the mitochondria to utilize the acid indicates the yield potential of the plant (1270X1231-3).

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Clifford M. Hardin, Secretary
U.S. Department of Agriculture

G. W. Irving, Jr., Administrator
Agricultural Research Service

Dr. McDaniel and graduate student Brian Grimwood screen the proteins extracted from mitochondria of different barley parents to evaluate the genetic differences of parents (0171X03–7).

Plant breeding shortcut

BREEDING PLANTS in test tubes may sound like yesterday's science fiction, but it could be today's reality. A revolutionary new breeding tool, called mitochondrial complementation, or MC, opens the way for test tube evaluation of the performance potential of crosses between selected plants.

Geneticist Robert G. McDaniel of the Arizona Agricultural Experiment Station, Tucson, working in a cooperative research program with ARS, is refining the new biochemical technique for testing plants for hybrid vigor and providing biochemical insight into its expression.

Use of the technique may greatly reduce the time now needed to develop and release a new cultivar or hybrid. Dr. McDaniel believes that proper use of MC would, by reducing the number of field tests of experimental lines, cut 2 years from a conventional 5-year breeding program.

Using barley, Dr. McDaniel isolates the mitochondria, microscopic respiratory bodies in cells, from proposed parent plants and mechanically mixes

them together in a solution. If the offspring of these proposed parents have a high yield potential, the mitochondrial mixture shows an increased respiratory rate—in contrast to the respiratory rate of either parent. Ninety-five percent of this superior mitochondrial activity is reflected in the respiration of plant tissues, which ultimately controls the rate and efficiency of the plant's growth.

Apparently, one basic control of growth potential and possibly crop yield rests in the enzyme activity of the mitochondria, Dr. McDaniel explains.

Conventional crossing and screening of new plant material involves hand-pollinating in field or laboratory, then waiting months for the seed to develop. Next comes harvesting and planting the new seed. Finally, growth, vigor, and yield of the new plants must be observed throughout the growing period. Out of many crosses, only a few might prove satisfactory.

Nature's time schedule would be short-circuited by MC testing, which would screen out early and quickly those crosses that would produce inferior offspring. Only plants which, when tested biochemically, show a high performance potential would need to be crossed and field tested. And, with further refinements of the biochemical-genetic relationship, even this testing might be further restricted.

The limitations of the MC technique appear to be relatively minor when compared to the time and space factors of conventional breeding. Dr. McDaniel explains that "although we can accurately predict the potential yield of a specific hybrid, we cannot yet predict whether the yield will be expressed as a high grain yield or high straw yield."

Dr. McDaniel's successful MC tests on crop plants other than barley, as well as on animals, has led him to predict that MC will add a new dimension to all breeding. Its potential was recently borne out by the formation of a new British cereal breeding company whose activities will be centered around MC research and breeding. ■

Technician Judy Pride separates proteins of mitochondria through electrophoresis during the screening and evaluation procedure for prospective barley parents (1270X1231–13).

FOAM BLANKET PROTECTS CROPS

WRAPPING tender young truck crops in blankets of insulating foam could save them from late or unexpected spring freezes, thus assuring a longer fresh vegetable season for the consumer.

Truck gardeners in the Lower Rio Grande Valley of Texas and other areas strive for the early market by gambling with the weather—a 50-percent probability of frost—and many times lose. Their alternatives in the past, except for doing nothing, were to sprinkle or flood irrigate or to cover the plants with cloth, paper, or plastic.

The idea of using an insulating foam that effectively retains heat stored in the soil near the young plants has been

Left: *Mr. Heilman measures temperature of foam at leaf height with thermocouple (1270A1179–9).* **Top:** *Dr. Bartholic and Mr. Heilman have attained the desired foam density in this trial application. Ideal density assures slow dissipation under early morning sun (1270A1180–18).* **Bottom:** *This premixed solid block is enough for 100 gallons of liquified mix. Each gallon with air added makes 60 gallons in volume of foam (1270A1183–7).*

probed by several research groups. But two needs had to be met: (1) an inexpensive stable foam that would last throughout a one-night frost and disperse in the heat of the morning, and (2) a simple, inexpensive, mobile generator.

Such a foam—nontoxic to plants and biodegradable in the soil—has been developed by ARS at Weslaco, Tex. The foam lasts from 8 to 16 hours, and plants inside the "blanket" are kept up to 22° F. warmer than those left outside.

Along with the stable foam formulation, ARS soil scientists Marvin D. Heilman and Jon F. Bartholic designed a foam generator for field application and a shallow trench planting technique.

A combination of three materials (Retzolate R30S, Pluronic F–68, and most important, gelatin), provides the foam-forming solution when added to water. Those materials may soon be available premixed in solid blocks ready to be placed in a predetermined volume of warm water, thereby eliminating the difficulties of mixing separate components.

Foam is formed in the generator by forcing air through porous 1-inch foam rubber in the bottom of a container holding the foam-forming solution. As the foam builds, it is forced from the container into foam-dispensing tubes at the rear of the generator and directed onto the crop rows.

The shallow trenches—made with a rotary corrugator or other implement—confine the foam to a limited area and cut foam requirements by 75 percent. Moreover, the trenches themselves keep young plants 2° to 3° F. warmer than plants on top of the bed.

Cost of foam protection will run about $30 per acre except for cantaloupes, where it will run about $15 since they are planted in rows twice as wide as most truck crops.

The Weslaco research, in cooperation with the Texas Agricultural Experiment Station, continues studies on improving the foam generator.■

Faster test for grain protein

PROTEIN CONTENT IN GRAIN—important in grading—can be determined by a new test that is simpler, faster, and cheaper than other methods.

The new test assays individual grain samples in about 35 minutes—three times as fast as the standard Kjeldahl test. Chemicals cost about 5 cents per sample compared with the usual 10 to 15 cents. And unlike other protein assays which involve complicated procedures sometimes requiring a chemist, the new test can be made by a technician.

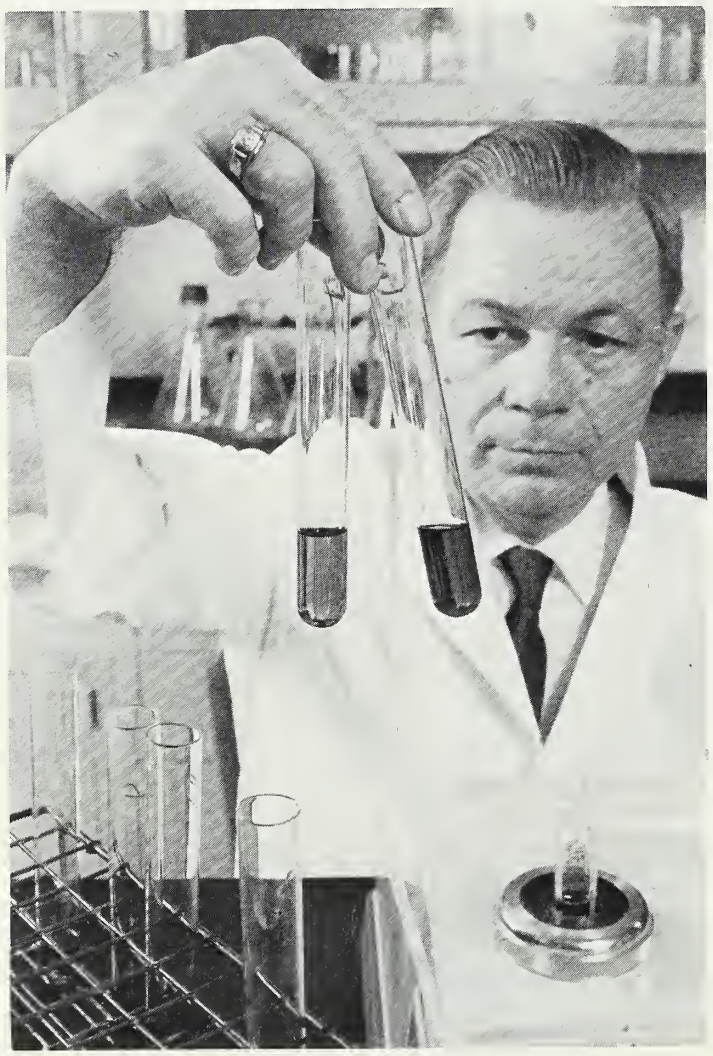
ARS chemist Robert M. Johnson, Beltsville, Md., adapted the test from conventional biuret methods of detecting proteins in biological materials. It is highly accurate, producing errors of less than 0.2 percent in a series of 342 trials. Dr. Johnson and technician Carolee E. Craney assayed barley, corn, grain sorghum, oats, soft red winter wheat, winter and spring hard wheats, and both hard and soft wheat flours. The samples, ranging from 7 to 16 percent in protein content, reflected the wide differences that dealers and feedmen encounter in grain.

To determine the effects of different growing conditions on grain quality, the Beltsville tests included grain from 3 crop years; test results attributable to different crop years were not found.

To develop a suitable test, Dr. Johnson experimented with various chemical reagents to overcome disadvantages of the older biuret methods. In the biuret reaction, chemical reagents produce a purple color, indicating the presence of protein. The deeper the color, the higher the protein content.

Normally, a brown discoloration distorts biuret tests with grain sorghum, corn, oats, and barley. Dr. Johnson and Miss Craney solved this problem through use of cupric carbonate and alcohol. In the new test, 1 gram of meal is mixed, in sequence, with measured amounts of alcohol, powdered cupric carbonate, and an alkali-alcohol solution. The mixture is then shaken, left to develop the purple color that indicates the protein content, filtered, and measured on a colorimeter. The color score registered on the colorimeter dial can be immediately converted to protein content by referring to a specially calibrated chart.

Although differences in color of the test solution are discernible by eye, the colorimeter provides a more sensitive and objective analysis which is important in establishing price premiums or penalties based on protein content. The new test utilizes equipment and materials normally available in laboratories, thereby avoiding the expense of purchasing specialized instruments and materials. ■



Dr. Johnson visually checks protein color before reading the colorimeter. The tube on the right with the darker solution has a higher protein content than the one on the left (171A24–11).

Miss Craney weighs grain samples. Samples are treated with cupric carbonate and an alkaline solution before protein content is measured (171A24–18).

Mrs. Virginia Morris determines the selenium content of liver sample extracts. She uses a spectrophoto fluorimeter (171A10–6).

Detoxifying dietary SELENIUM

HOW TO COMBAT selenium poisoning, which causes death of cattle and sheep in certain areas of the country, is part of an over-all study of trace minerals as they relate to human nutrition.

Either too little or too much of this element can be harmful, and the margin for error is relatively small. Less than one-fifth of an ounce in a ton of hay prevents nutritional deficiencies in livestock which cause degeneration of the liver, pancreas, heart, or muscle tissue, depending on the animal species. But the mineral is also highly toxic.

Previous research indicates that several materials decrease selenium toxicity and that each acts uniquely. It is believed that the amino acid, methionine, works with vitamin E to decrease selenium residues in the organs; that arsenic stimulates excretion of selenium through the bile, thus decreasing its toxic effects; and that linseed oil meal increases the ability of body tissues to bind selenium in a less toxic form.

To verify the interaction of methionine and vitamin E and to learn more about the way these two compounds work together, a team of ARS scientists in the Beltsville, Md., human nutrition laboratories studied the response of female weanling albino rats to high-selenium diets. Chemist Orville A. Levander headed the team.

All rats were fed a basic peanut meal ration devoid of vitamin E with 10 parts per million selenium added. One group received a methionine supplement; one received vitamin E; others were given supplements containing both methionine (0.5 percent) and vitamin E at different levels (0.01 to 0.05 percent). In other groups, certain antioxidants were substituted for vitamin E.

Rats receiving the selenium-peanut meal diet without a supplement of methionine or vitamin E showed moderate to severe liver damage. Adding either alone had only a slight beneficial effect. All combinations of methionine and vitamin E protected against selenium poisoning, with the best protection at the higher vitamin E levels.

When certain fat-soluble antioxidants—ethoxyquin (Santoquin), butylated hydroxytoluene, and N.N′-diphenyl-p-phenylenediamine — were added to the diet in place of vitamin E, animals were protected in varying degrees. These compounds, which together with methionine protected against liver damage caused by selenium toxicity, were the same compounds previously reported to be active against acute liver damage in selenium-deficient rats. The water-soluble antioxidants, methylene blue and ascorbic acid (vitamin C), were ineffective.

Animals receiving any of the protective supplements showed lower selenium levels in the liver and kidneys than those fed the selenium-peanut meal diet without supplement.

Because selenium itself is considered an antioxidant, it is believed unlikely that vitamin E and the effective fat-soluble antioxidants are acting as antioxidants. Rather, Dr. Levander suggests that vitamin E and the fat-soluble antioxidants make the methyl component of methionine more available for use in detoxifying the selenium.■

Weevil lays eggs visible between paper strips. Eggs per cluster number from 30 to 264. They hatch in 7 days (1270A1175–14.)

This wasp parasite attacks eggs instead of larva or adults. Here, an adult wasp prepares to deposit her eggs in a mass of weevil eggs. Upon hatching, wasp larvae will eat their way out, devouring the weevil eggs (1070X999–2).

WASPS THAT GUARD

A DESTRUCTIVE CITRUS PEST from the Caribbean that has invaded Florida may be meeting an old enemy from home.

By introducing biological control agents before the pest gets firmly established, scientists hope to help prevent heavy damage to citrus crops without environmental pollution problems that might accompany conventional control measures.

Known as the sugarcane rootstalk borer weevil, *Diaprepes abbreviata*, the pest has several plant hosts. It represents a more serious threat to citrus trees, however, than to other crops in the United States at this time. Adult weevils feed on citrus leaves, and the larvae attack the roots.

In Puerto Rico, ARS entomologists Barnard D. Burks and Allen G. Selhime found a tiny parasitic wasp, *Tetrastichus haitiensis*, which is harmless to man but an important parasite of the weevil. The adult wasps seek out the weevils' eggs and deposit their own eggs in them. Upon hatching, the larvae of the parasite devour the weevil eggs.

After determining that the wasps would cause no problems if introduced in the United States, Mr. Selhime and Dr. Burks obtained several hundred of them for further study in the laboratory. At Apopka, Fla., Mr. Selhime and technician Rouselle A. Sutton speeded and simplified laboratory production of the parasites over that in nature by modifying the host weevils' egg-laying habits. The female weevil normally sandwiches her eggs between two citrus leaves which protectively adhere to the eggs. Mr. Selhime and Mr. Sutton found that the weevils will just as readily deposit their eggs between the folds of wax paper strips, which are then moved into laboratory cages containing the parasites.

About 90 percent of the weevil eggs are subsequently parasitized, permitting production of about 25,000 adult parasites per week under present procedures. Much larger numbers could be reared if needed.

In preliminary field tests, Mr. Selhime and Mr. Sutton released 86,000 parasites in the Apopka area, where the weevil was first discoverd. Weevil eggs attacked by the wasps have been recovered, providing preliminary evidence that the parasite is reaching its

Mr. Selhime inspects root damage in an infested citrus orchard. Weevil larvae feed on roots, and adults feed on leaves. Adult weevils are social in habit—often one tree will harbor hundreds while a nearby tree has none (1270A1177–11).

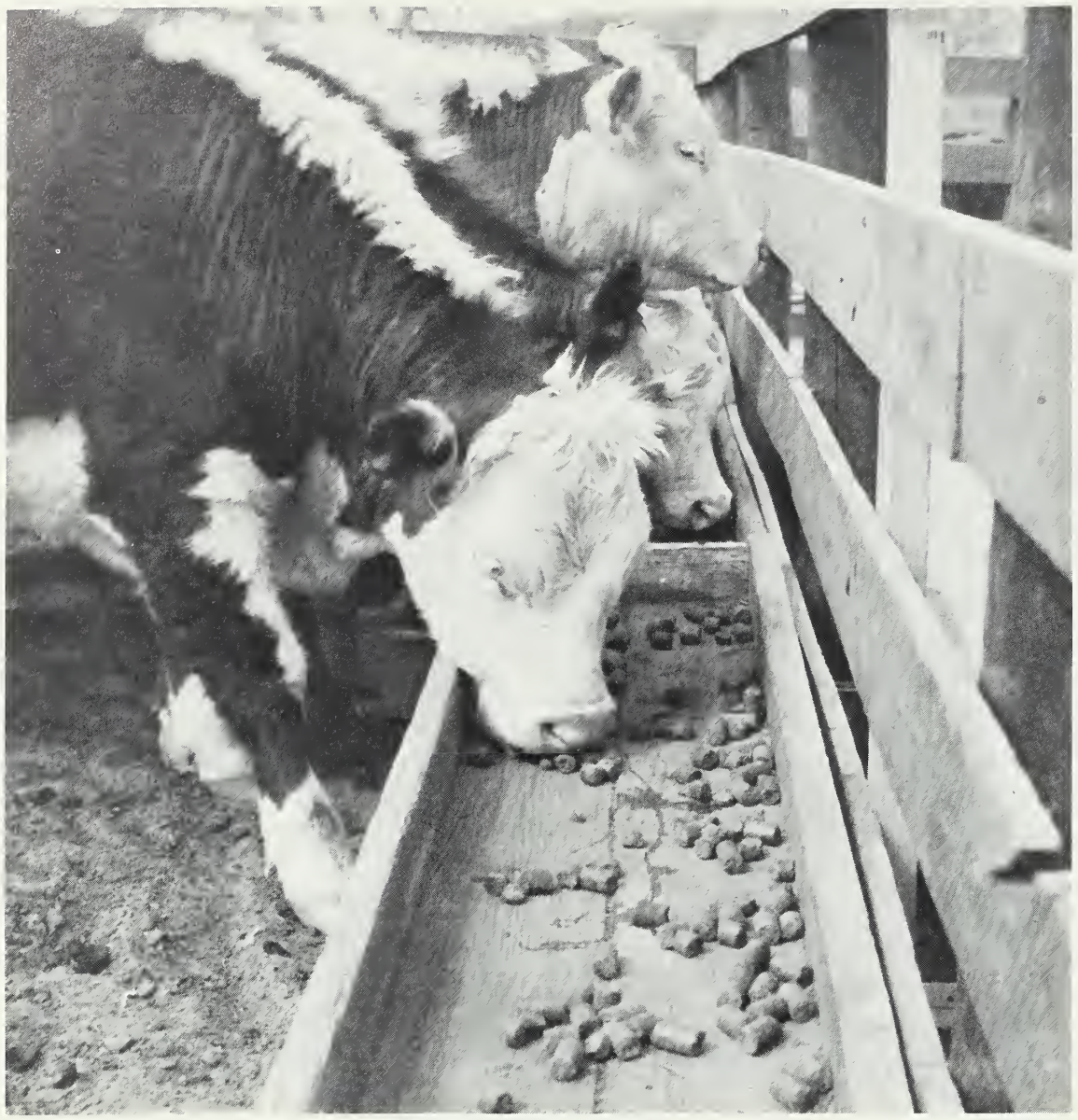
CITRUS

target. If further surveys demonstrate that the parasite can establish itself as a natural control agent in the Florida climate, further releases will be made on a larger scale.

The parasite has several points in its favor. A new generation of wasps can be produced in the laboratory every 3 to 4 weeks, greatly outnumbering the weevils, which have a 1- to 2-year life-span. If the parasites cannot find enough eggs of the sugarcane rootstalk borer to parasitize, they can live on several other destructive pests, including the Fuller rose beetle, and two citrus root weevils, *Pachnaeus litus* and *P. opalus*.

The Florida Department of Agriculture is cooperating in this biological control project. ■

Mr. Sutton introduces weevil larvae to citrus seedlings in tests to develop new mass-rearing techniques. The insects prefer young trees or nursery stock (1270A1174–27).



All steers in these tests were weighed bimonthly to measure treatment responses. The 100- to 125-percent efficiency in gains from the combined practices should apply in practice unless there are limiting factors such as overstocked ranges (PN–1942).

The right combination BOOSTS RANGE STEER GAINS

ONE good management practice deserves another—at least that appears to be the case with range steers.

Long-held beliefs of cattlemen that combining management practices tends to cancel or suppress the full effects of the practices used alone have been disproven by range scientist Marvin C. Shoop and agronomist E. H. (Pat) McIlvain. The ARS researchers found that combining four practices did not reduce the advantages of the practices used individually and, in some instances, increased them. For example, if feeding additional cottonseed cake to a steer increased the gains 20 pounds per year, it increased gains 20 pounds plus when combined with several other practices.

Improved management practices were studied alone and in combination at the U.S. Southern Great Plains Field Station, Woodward, Okla., in cooperation with the Oklahoma Agricultural Experiment Station. Under study were: moderate grazing, additional winter and late summer cottonseed cake, and use of stilbestrol, a growth-promoting hormone.

Sand sagebrush with an undergrowth of short, mid, and tall grasses composed the range vegetation. The land was rolling but stabilized sand dunes of loamy sand soils. The test animals were uniform Hereford calves averaging 470 pounds at the beginning of each of the three year-long experiments.

Results of using the management practices singly were: Yearly steer gains were raised 15 pounds per animal when range stocking rate was increased from 6 to 9 acres per steer. Feeding 41-percent additional cottonseed cake during the winter months increased gains 20 pounds per steer. Cottonseed cake fed in late summer increased gains 10 pounds per animal on a yearly basis. Twelve milligrams of stilbestrol, implanted in each animal twice yearly, improved gains 45 pounds per steer.

By selecting different three- and four-combination practices, the scientists proved that these combinations were as effective when combined as when applied individually. Combining all four increased year-long gains per steer as much as the sum of the practices applied singly—90 pounds.

During the winters, combining three of the practices increased gains 25 percent more than if they had been applied alone and the gains totaled.

Also, rate of hair shedding increased, a sign of good nutrition, when the management practices were combined.

Although these findings indicate that stockmen can benefit through combined practices, they should not overstock their ranges hoping to make up the difference with management practices. This is false economy, because overstocking causes severe damage to the range vegetation and land alike. ■

Holsteins in the feedlot

HOLSTEIN CATTLE, whose top production has long made them popular in milking parlors, have also made a good showing in feedlots. Facing formidable competition from beef and dairy breeds, Holsteins were first for rate of gain in ARS feeding trials.

Holstein, Jersey, Milking Shorthorn, Angus, and Hereford steer calves were included in the trials, with half of the cattle from each breed on a high and half on a low plane of nutrition from birth to 180 days. The high-plane diet included large quantities of whole milk; low plane was typical for rearing dairy heifers, using milk replacer, grain, and hay.

At 181 days, the calves were divided by breed and previous treatment into three groups and fed free choice: finishing ration; chopped hay mixture; or chopped hay until five-sixths of slaughter weight, then finishing ration to slaughter.

Research was conducted by animal scientists Norman W. Hooven, Jr., James Bond, Everett J. Warwick, and Richard L. Hiner at Beltsville, Md.

Holsteins gained fastest in both phases of the trials. They also had the largest rib-eye area (meaty portion of a rib cut) and highest percentage of lean meat and bone of any breed in the study.

Beef breeds produced the most fat; Holsteins, the least. Jerseys and Angus were most tender by taste panel scores.

At equal slaughter weights, Holstein steers will not grade as high as beef breeds because of a lack of fat. While they can reach live weights of 1,000 pounds in about a year, they may need to reach 1,400 pounds to add extra fat for higher grade. That extra fat might be too expensive to make it pay. Producers should weigh possible grade discrimination against faster rate of gain before deciding.

Dairy steers from the larger breeds can be profitably fed to feeder or market weights. Thus, a dairy beef enterprise can offer an additional source of income for dairymen if they have extra labor, feed, and facilities available over and above those which are necessary for normal dairy operation.

Also, the larger dairy breeds may provide potential germ plasm to the beef industry.

Meat from cull dairy cows and bulls has always been used for processed meats and hamburger, and there is every reason to believe that dairy beef will supply a larger proportion of beef cuts in the future, especially with consumer preference for more lean. As Mr. Hooven points out, "If beef is lean, tender, and flavorful, consumer acceptability will be high regardless of breed." ■

Mr. Hooven (left) inspects herd of holsteins that rated high in the feeding trials (0271X112–18).

Equation predicts phosphorous needs

PREDICTING the exact amount of phosphorus needed by a given crop species on a given soil may soon be possible.

This knowledge is vital to farmers and society. Too little phosphorus means smaller crops. Too much phosphorus, besides wasting fertilizer, raises the possibility that some may get into streams and lakes and contribute to eutrophication (enrichment). Although the bulk of europhication due to phosphates stems from industrial wastes and municipal sewage, ARS is trying to find ways to reduce phosphates contributed by agricultural activities to an absolute minimum.

Learning how soils supply phosphorus to plant roots underlies an equation which, when certain variables are inserted, can predict the exact amount of phosphorus required to carry a crop through a season.

The equation depends upon estimating: (1) The ability of certain soils to supply soluble phosphorus by diffusion from the solid form adsorbed on soil particles to the liquid form needed by plant roots; (2) how much fertilizer phosphorus certain soils will adsorb, and (3) how much phosphorus plant roots will take up from seedling to maturity. This approach may show that farmers need apply only enough phosphorus to keep up the "reservoir" in the soil.

Variables in the equation take into account the finding that each soil type differs in its ability to supply phosphorus to plant roots. Working with corn, ARS soil scientists Sterling R. Olsen and Frank S. Watanabe, Ft. Collins, Colo., found that to supply equal amounts of phosphorus to roots, Pierre clay needed 40 parts per million phosphorus (as concentrated superphosphate) while Apishapa silty clay loam required 29 ppm, and Tripp fine sandy loam only 20 ppm.

At the same concentration of phosphorus in solution, the average rate of uptake over 24 hours was approximately five times greater in the Pierre clay than in the Tripp fine sandy loam. The scientists also found that the fertilizer phosphorus needed by these three soils correlated closely with the percentage of clay in the soil—the more clay, the more phosphorus required.

Critical problem in this approach is predicting what demand the roots will make on the phosphorous solution, since that determines the actual amount of phosphorus supplied by the soil to the solution. This demand will vary with growth of the plant and the efficiency of the root system.

Although knowledge of the entire process of phosphorus diffusion in soils is far from complete, Dr. Olsen and Mr. Watanabe found that the amounts of fertilizer phosphorus, calculated from the diffusion equation, correlated well with yield responses to applied phosphorus in greenhouse trials. ■

Phosphorus overrated as pollutant?

AN ARS STUDY of seven farm ponds tends to support other studies that indicate phosphorous may not be a major cause of eutrophication—enrichment—and the growth of algae.

ARS soil scientist Richard W. Terkeltoub, who made the study, found no discernible relation between soluble inorganic phosphorous concentration and the presence or absence of algae in the ponds, which were located in a 30-square-mile area of eastern Pennsylvania.

Algae grew in some ponds with phosphorous concentrations well below 15 parts per billion (ppb) and did not grow in others having concentrations well above that supposedly critical level. By way of comparison, streams draining forested areas with little habitation or land use often exceed 8 ppb phosphorous concentrations.

Algae grew in three ponds and did not grow in four. The pond with the greatest algal growth also had the highest average phosphorous concentration, but two ponds with average concentrations greater than 15 ppb showed no algal growth. Furthermore, the average phosphorous concentration in a pond with growing algae was only about 8 ppb. All of the algae-free ponds had greater average phosphorous concentrations than did this pond during the period of study.

Dr. Terkeltoub, who works in cooperation with the Pennsylvania Agricultural Experiment Station, is at the ARS Northeast Watershed Research Center, University Park, Pa. ■

the question of protein

Differences in feeds can affect protein utilization by ruminants

SMALL DIFFERENCES in high-quality feeds can affect protein utilization by cattle, sheep, and other ruminants.

Protein utilization by ruminants is a problem of major concern to the livestock industry. Under an ARS-sponsored Public Law 480 project, Israeli scientists used yearling and adult rams to compare different kinds of high-protein feeds with and without supplemental starch.

The scientists organized their research around several important questions. For example, does increasing starch intake affect protein utilization? Answer: yes for adult rams; no for yearlings.

In comparing high-quality forage (alfalfa) and high-quality oilseed (toasted soybean meal), the scientists found the forage to be superior in protein efficiency. Forage protein efficiency also proved superior in a comparison of soybean meal and oat-vetch hay.

The Israelis experimented with a 50–50 mixture of soybean and alfalfa proteins to see if the combination would produce a synergistic effect. This effect was confirmed, with slightly better results than when either forage or soybeans were fed separately.

Further, the Israelis determined that supplementing a poor-quality roughage (Rhodes hay) with 5-percent alfalfa meal increased live-weight gain and feed efficiency. However, supplementing a mixture of concentrates and a better quality forage (vetch hay) with 5-percent alfalfa had little or no effect.

These applied feeding tests were supported by biochemical studies. For example, alfalfa and soybean meal showed little difference in protein solubility, which has been associated with protein quality in ruminants.

However, there was a difference in free amino acid composition which was associated with nonprotein nitrogen (NPN) content. Only 1.5 percent of the nitrogen of soybean meal was NPN, but the NPN of alfalfa nitrogen was 25.5 percent, mostly amino acids—proline, alanine, valine, and serine. This greater NPN fraction may have helped increase rumen microbe activity, which is important to digestion in ruminants.

The researchers also found that the amounts of the total and most of the individual volatile fatty acids (VFA) were considerably higher with the alfalfa than with the soybean meal diet. The proportions of acetate and propionate, the VFA that occur in greatest quantity, were related to the source of carbohydrate. More closely related to the source of protein, however, were the butyrate, valerate, caproate, and isocaproate, the VFA that may stimulate microbial activity. Higher amounts of the protein-related VFA, which may be derived directly from amino acids, could have contributed to the superiority of the alfalfa diet.

The Israelis also worked out a simple way to measure dehydrogenase activity of rumen fluid. Dehydrogenases are enzymes involved in both breakdown and synthesis, particularly of amino acids and proteins. Using the dye tetrazolium chloride, which was incubated with a small amount of rumen fluid and a buffer to control the pH, the scientists found they could quickly correlate the color density to the proportion of the dehydrogenase activity.

Conducted at the Hebrew University, Rehovot, this project was researched by Dr. H. Tagari and Dr. Y. Dror under the direction of Dr. Aron Bondi. Dr. Paul J. Reynolds, nutritionist at Beltsville, Md., was the ARS sponsoring scientist. ■

All-weather bee house

A FIELD LABORATORY for bee research permits year-round studies regardless of the weather.

Some scientists have attempted to avoid weather limitations by moving the bees inside to a controlled environment, but indoor locations have proved too expensive and inadequate for rearing bees.

Entomologist Stephen Taber III and engineer Charles Owens, however, can maintain work schedules in their experimental laboratory despite such difficulties as dust devils, temperatures ranging from 32° to 104° F., rain and snow, and relative humidity as low as 4 percent. Their studies are at ARS' Bee Research Laboratory, Tucson, Ariz.

The bee house differs from usual facilities in that heating, cooling, and lighting systems are designed primarily for the beekeeper and not for the bees. This radical philosophy on bee house design resulted when, after extensive testing, they found that bees can usually take care of themselves when they have adequate populations, honey, pollen, and water.

Nothing about the bee house is so unique that it must be duplicated exactly. The basic structure is a modified trailer shell.

The heating and cooling systems keep the temperature between 79° and 84° F., since at these temperatures, bees maintain a constant cluster space, and researchers find them easy to work with.

Three continuous rows of double fluorescent lamps provide enough light to see bee eggs, small larvae and queens, and the lamps are better for the bees than sunlight as heat from the sun could have a detrimental effect on the cells.

One end of the bee house was sectioned off and used as a field laboratory for queen rearing, instrumentation, insemination of virgin queens, collection of larval foods, and general record keeping.

This type of laboratory may be conveniently close to the colonies, without exposing experimental material to an unfavorable environment.

The researchers note that two important aspects of managing a successful bee house are:

- Feeding the colonies pollen cake when brood production declines. They used a formula containing one-part pollen and three-parts soy flour when colonies showed symptoms of pollen shortage (a reduction of drone and worker brood).
- When working at night or during harsh weather conditions, keeping the brood area above a super body filled with comb to allow the older bees cluster space so work can be done with a minimum of stings. ■

'Squeezing' lettuce---electronically

HOUSEWIVES may someday prepare salads with lettuce harvested by mechanical pickers whose principal component—a head selector—gives the lettuce an electronic squeeze to make sure it is ready for the table.

Until plant breeders develop a lettuce in which all heads mature at the same time, more than one trip through the field is necessary by hand pickers or mechanical harvesters to pick heads as they "ripen."

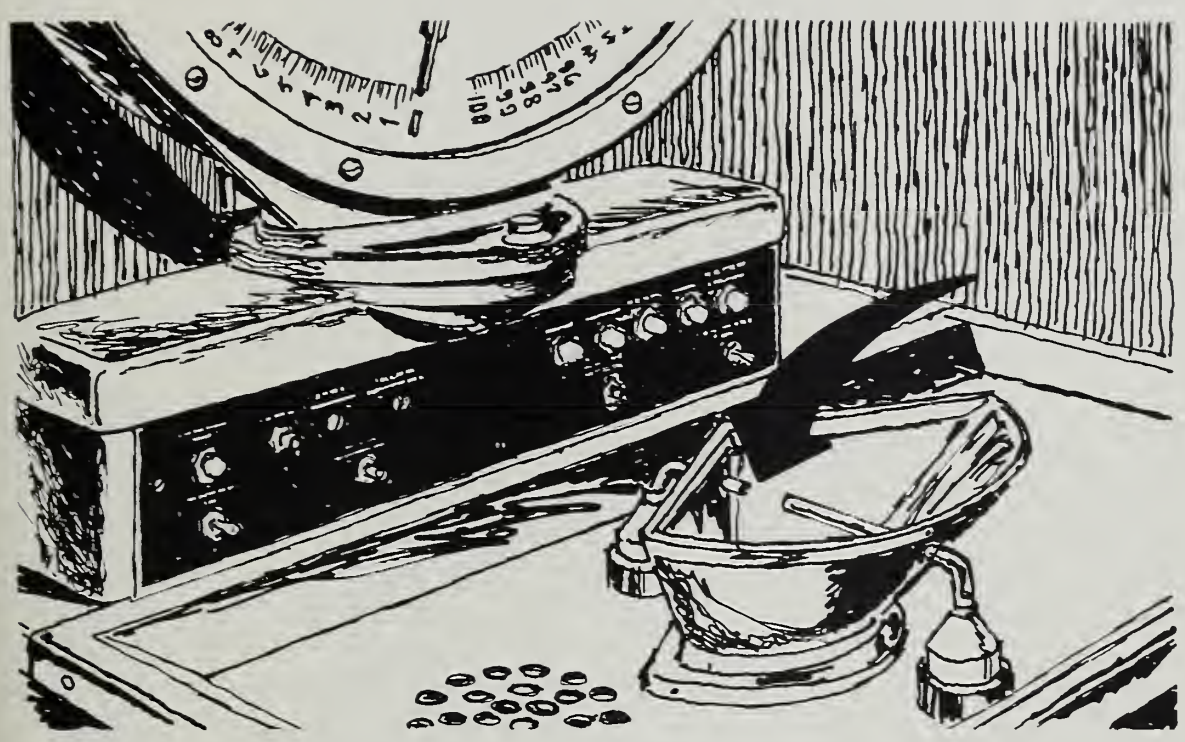
Mechanical harvesters for iceberg-type lettuce have been under development for several years, but the key to such a harvester is a selector device to point out mature heads. Although there is an accurate selector that transmits gamma rays through lettuce heads, obtaining government clearance for necessary radioactive material has been a problem. Further, restrictions might be placed on ownership and operation of such harvesters.

By contrast, an X-ray selector, developed and successfully tested in the laboratory by ARS agricultural engineers Don H. Lenker and Paul A. Adrian at Salinas, Calif., could be cleared for field use more easily and would probably have fewer restrictions on its ownership and operation.

The Salinas head selector, researched in cooperation with the California Agricultural Experiment Station, employs a small inexpensive medical-type X-ray head. Lettuce heads pass between the X-ray unit and a photodiode to determine the density—maturity—of the head. One advantage over mechanical selectors is that the Salinas selector does not touch the heads, eliminating possible damage.

The researchers are continuing their study under field conditions. ■

AGRISEARCH NOTES



Grain fills funnel until sensor (arrow) activates light on panel. Pushing button drops grain into kettle, and strike-off mechanism zigzags across top to sweep off excess. Scale indicates bushel weight (PN–1943).

Automatic device weighs grain

The weight per bushel of grain can be determined by an automatic device at least twice as fast and with about the same accuracy as the official manual method.

Establishing the test weight is important in determining the price of grain. An automatic weighing device would have considerable advantage at terminal elevators where hundreds of tests are made daily. The device could also be incorporated into an automated grading system in conjunction with dockage removal and moisture testing of grain.

Results from the automatic test device in experiments at Beltsville, Md., were comparable, within 0.1 pound, with those of the official manual method for wheat, corn, oats, barley, and grain sorghum. However, the 0.1 pound tolerance was exceeded in tests with soybeans and flaxseed.

The automatic device was developed by Midwest Research Institute, Kansas City, Mo., under an ARS contract.

The device saves considerable work and time by automating four steps of the official manual method: (1) transfer of grain from filling hopper to test kettle, (2) strike-off of excess grain, (3) weighing of grain, and (4) emptying of test kettle.

The experiments are part of an ARS research program to increase the accuracy and efficiency of grading grain and other commodities by developing equipment and procedures that will reduce the time, cost, and subjective factors now involved in manual grading systems.

Combined herbicides for pastures

Herbicide combinations now permit the hitherto impossible control of weed grasses in the establishment of grass-legume pasture mixtures.

Field experiments tested mixtures of WL–304 alfalfa with commercial orchardgrass, and Dawn birdsfood trefoil with Ioreed reed canarygrass. They were sprayed with individual herbicides and with combinations when the alfalfa and broadleaf weeds were 3 to 5 inches tall and weed grasses, orchardgrass, and reed canarygrass were 1 to 2 inches tall.

Herbicide MSMA combined with 2,4-DB and MSMA with bromoxynil were the most effective. Both combinations killed almost 100 percent of the weeds, and yields of the grass-legume mixtures increased as much as 60 percent.

ARS agronomists Elroy J. Peters and Samuel A. Lowance, conducted the research in cooperation with the Missouri Agricultural Experiment Station, Columbia.

MSMA and bromoxynil are not registered for the use tested in these experiments. Additional studies are needed to determine and evaluate any factors that possibly could have an adverse effect on the environment.

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AGRISEARCH NOTES

Severe storms and erosion

More than 50 percent of the annual soil loss on a small farmland watershed in Mississippi was caused by only 6 percent of the total rainfall. This 6 percent fell at excessive rates in several severe storms.

The loss came during the 2-month period from seedbed preparation and planting until early growth. ARS hydraulic engineering technician Jackie D. Greer's 6-year study was on loess corn land with plot slopes of about 3, 5, and 10 percent.

High energy of the raindrops from excessive storms broke up the unprotected soil, which was then lost in runoff.

Mr. Greer cooperates with the Mississippi Agricultural Experiment Station, Holly Springs.

Perfumed plants attract more bees

A scented sucrose solution sprayed on plants may attract forager honey bees, thus giving the sprayed plant species a definite survival advantage over odorless competitors.

Studies of scents as a means of directing bees to certain crops were conducted by ARS entomologist Gordon D. Waller at the Bee Research Laboratory located in Tucson, Ariz. Increasing bee visits to crops may be of great practical value in pollination.

Dr. Waller sprayed Moapa alfalfa plots with combinations of citral, geraniol, and anise at concentrations of one part scent per 1,000 parts water.

When applied separately, all three scents failed to increase bee visitation unless used with sucrose. Attraction was greatest with combinations of two or three scents and sucrose.

Results of the present study are promising. However, further work is needed to determine the basis for attraction and to learn the extent to which increased bee visitation actually improves the pollination and yield of specific crops.

Controlling halo blight

Halo blight, a serious disease threatening the colored dry bean industry of Michigan, can be controlled with copper-containing fungicide sprays until resistant bean varieties become available.

Halo blight, caused by a bacterium, attacks all colored dry bean varieties grown in Michigan. The bacteria invade the plant through natural openings in the leaves or through wounds. In time, the entire plant may yellow and die. Pod infection develops rapidly, and the seeds may also be invaded. As a result, blight-free seed for planting has been in short supply in recent years and has contributed to the disease buildup.

After the disease was discovered, ARS launched a breeding program to incorporate halo blight resistance into Michigan colored bean varieties, but resistant varieties are not yet available. In the interim, however, crops can be effectively protected by copper-containing sprays, report ARS plant pathologist Alfred W. Saettler and extension plant pathologist Howard S. Potter, Michigan Agricultural Experiment Station, East Lansing, after 4 years of field trials. Not only do the sprays control the disease in the field, but they also may reduce seed infection, which is particularly important in any halo blight control program.

Michigan produces about 26 percent of the red kidney beans, 97 percent of the cranberry beans, and 100 percent of the yelloweye beans grown in the United States.

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